Project Title: Pheromone Based Mating Disruption as an Alternative Grub Control Strategy for School and College Athletic Fields

Project Managers:
Tamson Yeh, Coordinator Pest Management Program for Suffolk County Properties tsy3@cornell.edu 631-727-7850 Ext: 240, Marie Camenares Pest Management Program for Suffolk County Properties mc249@cornell.edu 631-727-7850 Ext: 382, Marie Boulier Pest Management Program for Suffolk County Properties mwb38@cornell.edu 631-727-7850 Ext: 212 Cornell Cooperative Extension, Suffolk County 423 Griffing Avenue, Suite 100
Riverhead, NY 11901-3071
Fax: 631-852-3205

Cooperator:
Barbara Zeidler, Grounds Maintenance Supervisor
zeidlb@sunysuffolk.edu
Suffolk County Community College Grant Campus
1001 Crooked Hill Road Brentwood N.Y. 11717 zeidleb@sunysuffolk.edu
Cell(631) 433-7106Office(631) 851-6879 Fax (631) 851-6755

Dan Gilrein, Extension Entomologist
Cornell Cooperative Extension of Suffolk County
LIREC 3059 Sound Ave.
Riverhead, NY 11901
631-727-3595
dog1@cornell.edu

Abstract: Oriental beetles in the grub stage are the greatest insect threat to turf on Long Island. There are few highly effective products for control of early instar grubs in turfgrass. Imidacloprid is therefore often applied amid concerns about its ability to leach plus the potential of negative impact on pollinators. The goal of this study is to determine the potential for mating pheromone use around turf at risk, like athletic fields and golf course tees, fairways and roughs as a lifecycle disruptor. If pheromone disruption proves successful, then we will have reproducible data supporting an effective alternative to imidacloprid. A standard football field can be protected by 53 of these units at a price of approximately $150 dollars, requiring no spray equipment and minimal exposure. This season's results were somewhat disappointing with 16.35% damage of the 48,000 square feet total test area still occurring on the premium football field at one test site, which was enough to prevent play due to the damage being concentrated in the center of the field. The second test site at that location had only 5.45% damage. Controls had 0.0015% damage each. This may be reflective of the severe drought and the fact that control areas were not irrigated this summer. At the second site, the treatment area had 6.2% damage versus the control which had 2.65% damage. The poor results this season may be reflective of drought, of a second and larger type of grub (northern masked chafers) attracting predators, and most importantly the inability to deploy pheromone units prior to peak flight (late June to early July is peak). We look forward to trialing the pheromone units again in 2017; the materials are

in hand and in cold storage and we suspect that proper timing (and hopefully less drought interference) will make a larger impact on populations.

Background and Justification: The greatest insect pest problem in turf on Long Island is caused by the immature "grub" stage of the root feeding scarab beetle, *Anomala orientalis,* or oriental beetle. The key to reducing damage is to prevent mating, egg laying, and consequent generations of grubs. Pheromone based mating disruption confuses adult male oriental beetles, preventing them from successfully locating females for mating by flooding the environment with the pheromone they use to locate prospective mates. Imidacloprid, the most common prophylactic control for white grubs, is increasingly under scrutiny for the potential to contaminate ground water and the potential to harm pollinators. School grounds in New York state are governed by the Child Safe Playing Act which leaves few options for successful grub control. Athletic fields are less able to withstand typical grub thresholds because of the amount of traffic and loss of footing a grub outbreak can produce. Installation of easy to work with pheromone impregnated discs that can be hung on a chain link fence around athletic fields or suspended from a small stake one to two feet above the ground and be effective at a distance of at least 60 meters (Rodriguez-Saona et al., 2009) would, if effective, be a solution to a major scourge of turfgrass.

Objectives:

1.-The overall objective is to establish an effective, reliable alternative to pesticides for grub control in athletic, golf, commercial and residential turfgrass and for sod production.

2. -Establish an alternative methodology to reduce the use of imidacloprid, a neonicotinoid insecticide, and thus prevent or reduce potential leaching and runoff of this product into ground and surface waters and unwanted effects on pollinators such as honey bees. **Previous projects that lead to the need for this one:** Dan Gilrein has established the utility of mating disruption in protecting nursery crops from oriental beetles. This is now an IPM technique in use for nursery production.

3.-Establish the use of an existing product in a new way: There is a commercial product called Oriental Beetle MD which provides pre-measured distribution units that are practical and relatively inexpensive. Oriental Beetle MD is labeled for turf use. The proposed trial would help to establish mating disruption as part of a standard IPM program for school grounds and athletic fields and provide statistical data on mating disruption as a practical application for turf on properties under pesticide prohibition or phase out.

4.-Evaluation: Statistic analysis of data on grub populations within the mating disruption area

5.-Extend this practice with its evaluation data to high imidacloprid use patterns such as golf course maintenance and green industry turf practices through seminars, factsheets, conference presentations, etc.

Procedures with brief explanation of each step:

Four athletic fields were chosen at Suffolk County Community College Grant Campus in Brentwood and two at Suffolk County Community College Ammerman Campus in Selden. We chose these fields on the basis of damage in previous years by oriental beetle grubs and on the fact that there was sufficient space between them so that the lures should not affect the control fields for attractiveness for egg laying, at least 100 meters between since research shows that males respond to pheromone at least 60 meters away (Rodriguez-Saona et al., 2010).

The pheromone was packaged as a small disc on a ring (see attached picture) containing 50 milligrams of pheromone (14.75% active ingredient) and on consultation with the literature, we installed the units 30 feet apart and at approximately one foot above the surface of the turf. Because of product availability and administrative delays on our end, we were not able to install mating disruption units until the third week of July when the normally the fourth week of June is peak mating time. This delay may have affected our final results but we have sufficient material to repeat the trial during peak flight in 2017 which we will do and submit a follow up report. Long Island experienced (and is still experiencing) severe drought (U.S. drought monitor) which tends to delay egg laying especially if drought conditions occur in late June and July (which they did).

54 units were installed around the perimeter of a total of 58,230 square feet of space, 48,000 square feet of which was the actual football playing field (300 feet by 160 feet). Each lure contained 50 mg of pheromone so the space was covered by a total of 2,700mg. Rodriguez-Saona et al. (2010) explained the principle of competitive disruption (also referred as competitive attraction), as "males are attracted to the point-source (i.e., synthetic pheromone) and the success of mating disruption is density-dependent". In work done on blueberries by Rodriguez-Saona et al., 2009, "When 25 dispensers containing 0.05 g of active ingredient (AI) were used per hectare, the numbers of males in female cages and larvae in sentinel pots were similar to controls. Thus, dispenser density was critical for successful mating disruption of oriental beetles. Male oriental beetles approach the dispensers at all times of the day according to field observations, indicative of competitive attraction as a potential mechanism for mating disruption. However, at peak activity, greater male attraction was observed to dispensers containing 0.1 g of pheromone than 0.05 or 0.025 g, demonstrating the importance of pheromone rate.... We conclude that deployment of 50 dispensers/ha at 0.1 g (AI) per dispenser is the most effective rate for mating disruption of oriental beetle in blueberries."

This translates to 5,000 mg/10,7639 square feet, or 2,705 mg/58,230 square feet which is our approximate exposure.

Fields were observed from the third week of July to the second week of October and the mating disruption units were removed at the end of October. Grid sampling was performed using the ten yard hashmarks of the football field on either side and divided by the center line for a total of 20 plots with 30 ft by 80 ft (240 square feet per plot). Ten golf course cup changer samples were taken per plot and the number of grubs in each sample recorded. Grub damage began to be observed on the premium football field of the two treatment fields during the third week of August on the premium football field enclosed by the track and were not present at all on the practice and ball fields which constituted the second pheromone treated area and controls. (Interestingly, peak damage occurred in the second week of September but did not progress any further even though other locations such as county golf courses did not experience any damage until late September and early October and damage continued to progress through the first week of November.) Damage was largely confined to the center of the football fields at grant campus and the center interior edge of the softball outfield, perhaps reflective of compaction which makes soil conditions warmer. Warm areas are more attractive for egg laying to oriental beetles. By the end of the trial period in mid-October, the total percent damage to each of the 20 treatment plots for each of the fields in square feet for the field sites was as follows:

Field Location	Plot number	Percent damage, square feet
Grant Campus football field	1	0%, 0
	2	1%, 24
	3	16%, 384
	4	8%, 192
	5	21%, 504
	6	2%, 48
	7	30%, 720
	8	21%, 504
	9	39%, 936
	10	48%, 1,152
	11	16%, 384
	12	31%, 744
	13	9%, 216
	14	28%, 672
	15	18%, 432
	16	13%, 312
	17	12%, 228
	18	8%, 192
	19	2%, 48
	20	4%, 96
Grant campus softball field	1	0%, 0
	2	0%, 0
	3	0%, 0
	4	0%, 0
	5	0%, 0
	6	0%, 0
	7	0%, 0
	8	0%, 0
	9	48%, 1,152
	10	1%, 24
	11	17%, 408
	12	15%, 360
	13	23%, 552
	14	3%, 72
	15	0%,0
	16	0%, 0
	17	0%, 0
	18	0%, 0
	19	2%, 48
	20	0%, 0
Grant campus practice field (control 1)	1	0%, 0
	2	0%, 0

	3	0%, 0
	4	0%, 0
	5	0%, 0
	6	0%, 0
	7	0%, 0
	8	1%, 24
	9	0%, 0
	10	0%, 0
	11	0%, 0
	12	2%, 48
	13	0%, 0
	14	0%, 0
	15	0%, 0
	16	0%, 0
	17	0%, 0
	18	0%, 0
	19	0%, 0
	20	0%, 0
Grant campus practice field (control 2)	1	0%, 0
	2	0%, 0
	3	0%, 0
	4	0%, 0
	5	0%, 0
	6	0%, 0
	7	0%, 0
	8	0%, 0
	9	0%, 0
	10	0%, 0
	11	3%, 72
	12	0%, 0
	13	0%, 0
	14	0%, 0
	15	0%, 0
	16	0%, 0
	17	0%, 0
	18	0%, 0
	19	0%, 0
	20	0%, 0
Ammerman football field	1	0%, 0
	2	0%, 0
	3	15%, 360
	4	0%, 0
	5	0%, 0
	6	18%, 432

	7	20%, 480
	8	0%, 0
	9	0%, 0
	10	1%, 24
	11	0%, 0
	12	0%, 0
	13	0%, 0
	14	20%, 480
	15	8%, 192
	16	30%, 720
	17	0%, 0
	18	12%, 288
	19	0%, 0
	20	0%, 0
Ammerman practice field	1	1%, 24
	2	4%, 96
	3	1%, 24
	4	12%, 288
	5	1%, 24
	6	1%, 24
	7	0%, 0
	8	1%, 24
	9	1%, 24
	10	0%, 0
	11	15%, 360
	12	0%, 0
	13	15%, 360
	14	0%, 0
	15	0%, 0
	16	1%, 24
	17	0%, 0
	18	0%, 0
	19	0%, 0
	20	0%, 0

Irrigation is a critical factor in choice of oviposition for scarab beetles, particularly in the throes of a drought. On the Brentwood campus, the football and softball fields were irrigated, the practice fields (controls) were not. There was an irrigation break on the softball field outfield that persisted for at least six weeks. The treatment and control fields at the Ammerman campus were both irrigated. Irrigation during drought makes areas more attractive for oviposition so we may have had gravid populations from outside the treatment area that flew longer distances to find a suitable oviposition site. Typically, oriental beetles emerge as adults, mate and then lay eggs a few feet from where they emerged---unlike Japanese beetles that do follow moisture patterns in the landscape. However, long term drought may cause variant behaviors.

An additional complication is that not all the grubs recovered during sampling were oriental beetles. About 13% of them were northern masked chafers (these were also observed during the late season outbreak on golf courses). These are a larger grub and thus should be more attractive to predators, perhaps leading to increased damage. The oriental beetle pheromone would have had no disruptive effects on mating of northern masked chafers. This population shift bears close watching for the future.

Results and discussion:

The results this season were disappointing but we feel that this is due to several factors: not getting the pheromone units out before peak flight, drought which may have brought gravid females from other nearby locations (lack of irrigation on practice fields may have made the irrigated softball and football fields more attractive), and the enticement of predators by the presence of northern masked chafers which would not have responded to mating disruption units for oriental beetles (http://archive.lib.msu.edu/tic/resuml/198.pdf.) We are looking forward to trialing the pheromone units for oriental beetles again in 2017. We already have the materials purchased and in cold storage for deployment during peak flight. This season we had the following and somewhat disappointing results when we look at percentages of damage in treated fields versus controls. At the Grant campus, 16.35% damage of the 48,000 square feet still occurred on the premium football field test site, which was enough to prevent play due to the damage being concentrated in the center of the field. The second test site at that location had only 5.45% damage. Control fields had 0.0015% damage each. Again, this may be reflective of the severe drought and the fact that control areas were not irrigated this summer. At the Ammerman campus, the treatment area had 6.2% damage versus the control which had 2.65% damage. Both of the Ammerman sites were irrigated and the northern masked chafer presence was minimal.

We will repeat the experiments in 2017 with the pheromone units that were purchased and are in cold storage and we will attempt to equalize irrigation on test and control fields. The other change we wish to implement is to deploy the units with better timing, just prior to peak flight (third week of June) AND we would like to deploy them at night. According to TurfGrass TRENDS • JULY 1996, http://archive.lib.msu.edu/tic/tgtre/article/1996jul9.pdf, the peak flight of males occurs from 7-11 pm with a maximum at 9 pm. Initial deployment at night may also alter the effectiveness in favor of better protection. Although in comparison to normal thresholds of grub damage a figure of only 16.35% seems manageable, athletic field turf is always under performance pressure due to high use and under scrutiny for potential athlete injury from poor footing. According to Terry Davis, Department of Entomology, Michigan State University, White Grub Control on Athletic Fields in Michigan (http://archive.lib.msu.edu/tic/mitgc /article/200095.pdf),

> "The thresholds for chemical control for home lawns are 5 per square foot for non-irrigated turf and up to 15 per square foot for irrigated turf. This is too high for athletic fields that are being heavily used."

The preliminary information on the use of mating disruption units and the plans for more research in 2017 will be reported to green industry professionals at lectures the NSLGA

conference, the Cauliflower Association Conference, the Brooklyn Landscape Gardener's Conference, the 2017 Golf Course Update program, and to homeowners at programs for Long Island Horticultural Society, and Spring Gardening School. We will also incorporate the information into articles for publication in in-house extension publications and will submit a second report to NYS IPM when the results of 2017 research are gathered and whether any practices will be altered or adopted with respect to grub control strategies.

9. Project location(s):
Demonstration/education projects were conducted in Suffolk County, New York on Suffolk County Community College's Brentwood and Ammerman campuses.

This research should be applicable in the Northeast where white grubs are problematic in turf and especially where water quality or the child safe playing act must be considered.

10. Samples of resources developed: (if applicable)
See photographs is attached files.

Literature Cited

CESAR R. RODRIGUEZ-SAONA, DEAN F. POLK, AND JAMES D. BARRY. 2009. Optimization of Pheromone Deployment for Effective Mating Disruption of Oriental Beetle (Coleoptera: Scarabaeidae) in Commercial Blueberries. Journal of Economic Entomology Vol. 102 No. 2 pp. 659:669.

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